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The Role of Learning Strategies in Second Language Acquisition: A Model for Research in Listening Comprehension

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This paper extends the discussion of Anderson's theory presented in an earlier paper and shows in detail how the theory can be used to describe the role of learning stategies in second language acquisition. While strategies used in acquiring productive language skills are discussed briefly, the model focuses on listening comprehension, since this is a fundamental skill and one that generally precedes other skills during acquisition. The model raises research questions concerning (a) mental processing during listening and (b) learning strategies that can be used to enhance listening comprehension. Keywords:

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The Instructional Technology Systems Technical Area of the Army Research Institute (ARI) has conducted research in the area of second language acquisition for several years. This research serves the Army's special interest in discovering the best methods for improving fluency in English among the many soldiers whose first language is not English. This report is the second in a series of three describing a project to discover these strategies that successful learners naturally employ in acquiring a second language. The ultimate goal of the project is a more effective training program that incorporates instruction in the application of those successful strategies.

This project was conducted as part of Program Task 3.1.1, Improving Job Skills Education for Soldiers, and under the authority of the Letter of Agreement for Soldiers, and under the authority of the Letter of Agreement entitled "Coordination of Efforts on the Job Skills Education Program (JSEP), Evaluation of the Army's Basic Skills Education Program (BSEP), and the Job Skills Education Program Academic Competencies Testing (JSEPACT)" (effective date, 20 April 1984). On 3 April 1987, Robert Ayers, Educational Program Administrator in the Army's Education Division, was briefed by Dr. Mark Sabol, ARI Research Psychologist, on the research methodology, results, and possible applications. The proposed applications of this project are within the Army's ongoing training programs in English as a second language. By identifying the learning strategies that successful students of English employ spontaneously, the project increases the effectiveness of such training programs through the addition, where deemed appropriate, of explicit training in the application of those strategies.

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Technical Director

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THE ROLE OF LEARNING STRATEGIES IN SECOND LANGUAGE ACQUISITION: A MODEL FOR RESEARCH IN LISTENING COMPREHENSION

EXECUTIVE SUMMARY

Requirement:

To facilitate gains in fluency in English among recruits for whom English is a second language.

Procedure:

On the basis of an earlier, extensive review of the literature, a model of the cognitive psychology of listening comprehension was developed. This model is based on Anderson's theoretical work.

Findings:

The model discussed in this report is capable of describing the role of learning strategies in second language acquisition. The paper discusses in detail the application of the model to the task of listening comprehension.

Utilization of Findings:

The model is used to generate questions concerning the mental processes involved in listening comprehension and the ways in which certain learning strategies can enhance listening comprehension skills. These questions can be researched and are, in fact, intended to be addressed in an empirical study; the description of such a study will constitute the third report in this series. The ultimate use of this work is the development of an English-as-a-second-language training program that would begin with instruction in the use of successful learning strategies.

THE ROLE OF LEARNING STRATEGIES IN SECOND LANGUAGE ACQUISITION: A MODEL FOR
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THE ROLE OF LEARNING STRATEGIES IN SECOND LANGUAGE ACQUISITION: A MODEL FOR RESEARCH IN LISTENING COMPREHENSION

The purpose of this report is to present a research model identifying the role of learning strategies in second language listening comprehension. The research model is designed to apply information from cognitive psychology in the explanation of how learning strategies assist second language listening comprehension. The model is intended to serve as a guide to the design and performance of research on learning strategies in second language acquisition, and to direct the development of hypotheses and the interpretation of results.

BACKGROUND

A review of prior research on the role of learning strategies in second language acquisition suggests that second language adolescent and adult learners consciously manipulate specific strategies that assist in facilitating the learning process and in improving learning and recall (O'Malley, Chamot, Walker, Russo, Kupper, Brooks, & Sabol, 1986). Initial studies in this area focused on identifying and classifying strategies used by good language learners (Naiman, Frohlich, Stern, & Todesco, 1978; O'Malley, Chamot, Stevner-Manzanares, Kupper, & Russo, 1985a; Rubin, 1975). Strategies were found in second language acquisition with all four language skill areas-- speaking, understanding, reading, and writing--and with both academic and nonacademic language tasks.

Second language learners who use active and varied strategies to assist their learning tend to be more effective learners than those who do not use strategies or who rely upon simple rote repetition (Politizer & McGroarty, 1985). Although some learners are adept at devising strategies to assist second language acquisition, many others tend to be ineffective at developing strategies and, consequently, may encounter difficulties in learning the language. However, learners can be trained to apply strategies for effective second language learning. For instance, strategy training has led to improved recall of vocabulary (Cohen & Aphek, 1981) and improved listening and speaking skills (O'Malley, Chamot, Stevner-Manzanares, Russo, & Kupper, 1985b). On the other hand, individuals may not always adopt new strategies if they already have had prior success with simpler strategies or if their training has not been sufficient to encourage transfer (O'Malley et al., 1985b).

The Need for a Research Model

The development of a research model to examine the role of learning strategies in cognition and second language acquisition is essential for improving our understanding of second language acquisition. However, an effective model for research should be based on a theory that explains the interaction between general cognitive processes, learning strategies, and second language acquisition. As the terms are used in the following discussion, a theory is a precise deductive system that is organized to produce specific predictions, a model is the application of a theory to a specific phenomenon, and a framework is a general pool of constructs for understanding

a domain that is not sufficiently organized to comprise a theory (after Anderson, 1983).

Additional work in second language acquisition and cognition will require specific direction and guidance from theory in order to progress beyond the realm of simple demonstrations of strategy use or effectiveness with various types of language tasks and learners. Theory should address the relationship between learning processes and learning strategies, and be capable of explaining how second language acquisition is facilitated through the use of learning strategies. The theory development should generate specific hypotheses concerning the learning strategies that are appropriate for different language skills, the types of language skills that will be responsive to strategy training with different learners, and the general learning conditions that will lead to improved second language acquisition. These hypotheses should be examined with regard to proposals derived from instructional theory. The theory development should result in the formulation of propositions that can be examined through research, and should suggest the nature of the research activities which will lead to improvements in knowledge.

Selection of a Theoretical Approach

Two paradigms on which theory has been based in explaining second language acquisition can be found in the fields of linguistics and cognitive psychology. Linguistic theories assume that language is learned as a separate system from cognitive skills and operates according to entirely different principles (e.g., Spolsky, 1985). This justifies analysis of the unique properties of language such as developmental language order, grammar, knowledge of language structures, and social and contextual influences on language use. Language and linguistic processes are viewed as interacting with cognition but nevertheless maintaining a separate identity that justifies investigation independent from cognitive processes (e.g., Wong-Fillmore & Swain, 1984). Not infrequently, varied social processes are brought into theory formulations that are related to motivation for learning (see Cummins, 1986; Gardner, 1979; Schumann, 1984; Wong-Fillmore & Swain, 1984). Cognitive processes, when represented at all in these theories, are typically concerned with various aspects of cognitive style and other predispositions for learning (see Wong-Fillmore & Swain, 1984). While of general interest as a reference point, these theories of second language acquisition are not useful in explaining the influence of learning strategies on second language acquisition because of their failure to treat cognition and learning in the context of the far larger and more impressive body of theory and research that has evolved in cognitive psychology. Theory development in second language acquisition that addresses cognitive processes remains limited despite recent interest in the relationship between language and cognition (Bialystok, 1978; McLaughlin, Rossman, & McLeod, 1983; Nagle & Sanders, 1986; Spolsky, 1985).

The second paradigm for theory development on second language acquisition emerges from cognitive psychology and is based in part on information processing and in part on studies and theory evolving over the past 15 or so years on the role of cognitive processes in learning. The role of learning strategies in the acquisition of information generally can be understood by reference to the information processing framework for learning. The purpose of this framework is to explain how information is stored in memory and, partic-

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ularly, how new information is acquired. In its simplest form, the framework suggests that information is stored in two distinct ways. Information is stored either in short-term memory, the active memory that holds modest amounts of information only for a brief period, or long-term memory, the sustained storage of information that may be represented as isolated elements or, more likely, as interconnected networks (Lachman, Lachman, & Butterfield, 1979; Mayer, 1977; Weinstein & Mayer, 1986). In some representations, the term "working memory" is used to describe short-term memory as a way of denoting the active use of cognitive procedures with the information that is being processed (Anderson, 1985).

New information is acquired through a four-stage encoding process involving selection, acquisition, construction, and integration (Weinstein & Mayer, 1986). Through selection, learners focus on specific information of interest in the environment and transfer that information into working memory. In acquisition, learners actively transfer information from working memory into long-term memory for permanent storage. In the third stage, construction, learners actively build internal connections between ideas contained in the information that has reached working memory. The information from long-term memory can be used to enrich the learner's understanding or retention of the new ideas by providing related information or schemata in which the new ideas can be organized. In the final process, integration, the learner actively searches for prior knowledge in long-term memory and transfers this knowledge to working memory. The sequence in which these processes occur may vary (Weinstein & Mayer, 1986). Selection and acquisition determine how much is learned, whereas construction and integration determine what is learned and how it is organized.

The role of learning strategies in this formulation is to make explicit and deliberate what otherwise may occur without the learner's awareness or may occur inefficiently during early stages of learning. Learning strategies are defined as "behaviors and thoughts that a learner engages in during learning and that are intended to influence the learner's encoding process" (Weinstein & Mayer, 1986, p. 315). Individuals may learn new information without consciously applying strategies or by applying inappropriate strategies that result in ineffective learning or incomplete long-term retention. Strategies that more actively engage the person's mental processes should be more effective in supporting learning. Strategies may become automatic after repeated use or after a skill has been fully acquired. Individuals who are apprised of presumably more effective ways of processing new information and learning can capitalize on some of these procedures depending on their individual motivations or interest in adopting new strategies.

The two-stage framework of short-term and long-term memory and the four mental processes described above are inadequate to meet the need for a theory to explain the effects of learning strategies on second language acquisition. The framework has been applied to problem solving, vocabulary learning, reading comprehension, and the acquisition of factual knowledge, but not to the full range of phenomena that form the totality of language. A theory is needed that addresses multiple aspects of language for integrative language use in all four language skill areas--listening, speaking, reading, and writing--and that addresses language acquisition from the earliest stages of second language learning to proficient use of the language. Further, the theory must be able to address language comprehension as a central issue, as

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is demanded by the research to be performed in this study. The two-stage, four-process explanatory framework of learning suggested above was not designed to address these concerns.

There are a number of ways to represent the competence that underlies performance of a complex cognitive skill such as language, including rational task analysis (Gagne & Paradise, 1961), interrelated procedural networks (Brown & Burton, 1978), and production systems (see Anderson, 1980, 1983, 1985). The focus of this paper will be on production systems for four reasons: (a) theoretical developments in that area cover a broader range of behavior, including comprehension and production of oral and written texts as well as comprehension, problem solving, and verbal learning; (b) the theory distinguishes between factual knowledge and cognitive skills during learning; (c) the theory can be expanded to incorporate learning strategies as part of the description of how information is learned; and (d) the theory has been continually updated, expanded, and revised in a number of recent publications (e.g., Anderson, 1983; 1985).

Overview

This paper first reviews the information processing theory of cognition and memory proposed by Anderson (1983, 1985) and shows how the theory can be used to describe language acquisition. As will be seen, the theory is sufficiently general to explain many of the phenomena and theoretical formulations discussed in the literature on second language acquisition. A second section of the paper reviews Anderson's view of cognitive processes involved in listening comprehension, the focal point of consideration in this study. A third second uses Anderson's theory to describe the acquisition of learning strategies and the influence of learning strategies on second language acquisition. While the theory does not specifically identify conceptual processes as learning strategies, Anderson's descriptions of mental processing during learning in many cases parallel the descriptions of learning strategies occurring elsewhere in the research literature (e.g., Weinstein & Mayer, 1986). The contribution of learning strategies to second language acquisition is described within the framework of the theory. Finally, specific research areas are identified that follow from the theory, accompanied by hypotheses concerning the relationship between conceptual processing, second language acquisition, and learning strategy use in listening comprehension.

COGNITIVE SKILL ACQUISITION

Language as a Cognitive Skill

The approach we have taken in developing the research model is that second language acquisition is being understood as a cognitive skill. The theoretical framework in which we will discuss second language acquisition therefore will be based on a comprehensive model of cognitive skill learning. This approach has several advantages. First, considerable research in cognitive skill acquisition has occurred in recent years in such disciplines as cognitive psychology and information processing aspects of computer sciences (Anderson, 1981). By applying relevant theories and models developed in these other disciplines to the study of second language acquisition, we are able to

provide a comprehensive and well-specified theoretical framework that is consistent with related work.

A second advantage to viewing second language acquisition as a cognitive skill is that the level of specificity and the "dynamic" or "process" orientation of models of skill acquisition allow us to provide a more detailed process view of second language acquisition than is provided by most current models of second language learning (see Chamot & Stewner-Manzanares, 1985). A third advantage is that viewing language acquisition as a cognitive skill provides a mechanism for describing how language learning ability can be improved. A fourth and related advantage is a pedagogical one and pertains to the development and use of learning strategies in second language acquisition. Anderson (1983, 1985) described cognitive skill acquisition as a "three-stage" process using a "production system" notation to specify the dynamics of the system during the skill acquisition process. This framework is particularly useful in the current context because it helps us to identify and test the existence and applicability of specific learning strategies that are appropriate at various stages in the skill acquisition process. Although it is recognized that biological/neurological factors also play a role in second language acquisition, the focus of the research model is on cognitive factors. The context of learning and social/affective factors will be addressed as they relate to the cognitive model.

Representation in Memory

Anderson (1983, 1985) distinguishes between what we know about and what we know how to do. All of the things we know about constitute declarative knowledge, and the things we know how to do are procedural knowledge.

Declarative Knowledge. Examples of things we know about include definitions of words, facts (such as "George Washington was the first President of the United States"), and rules (such as "i before e except after c"). Declarative knowledge need not be verbal. Although it often takes the form of abstract propositions, declarative knowledge can also take the form of temporal strings (cf. Tulving, 1983) such as our memory for the order of events--that is, which things came earlier and later in our lives, or the form of images (cf. Gagne & White, 1978) such as our memory for what a zebra looks like or the arrangement of our living rooms. Although the following "rule of thumb" is not always true, declarative knowledge can usually be expressed verbally or "declared." Thus, we typically are able to describe the contents of declarative knowledge.

Knowledge is maintained in long-term memory in terms of meaning rather than in terms of precisely replicated external events. While images and temporal strings play a role in memory, as suggested above, the most significant mode of storing information in memory for the analysis of language is through propositional representations (patterned after the approach used by Kintsch, 1974). Propositional representations maintain the meaning of information while ignoring unimportant details. Each proposition is denoted by a relation followed by an ordered list of arguments. In an example used by Anderson (1985),

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> Nixon gave a beautiful Cadillac to Brezhnev, who is leader
> of the USSR,

the relations correspond to the verbs (give, is), adjectives (beautiful), or other relational terms (leader of), while the arguments correspond to the nouns (Nixon, Cadillac, Brezhnev). The full ordered list of relations and arguments necessary to describe the proposition expressed in the above sentence is usually expressed in parentheses and would include the agent of giving, the object given, the recipient of the giving, and the time of the giving as in

> (Give, Nixon, Cadillac, Brezhnev, Past)

In a propositional analysis, each complex sentence such as the one above is differentiated into a number of simpler propositions on which the truth of the main proposition rests, such as,

> Nixon gave a Cadillac to Brezhnev.
> The Cadillac was beautiful.
> Brezhnev is the leader of the USSR.

These simpler propositions and their respective relations and arguments can be used to generate another original sentence, whose essential meaning would not change, such as,

> The leader of the USSR, Brezhnev, was given a Cadillac by
> Nixon and it was beautiful.

Anderson indicates that relations and arguments in a propositional analysis can be represented schematically by a propositional network, as shown in Figure 1. Each proposition in Figure 1 is represented as an ellipse, which is connected by labelled arrows to its relations and arguments. The basic unit or element of the propositional network is a node, as shown in Figure 1 by the ellipses. The arrows connecting each node to its relations and arguments are referred to as links. The nodes are similar to the more commonly used term ideas, and the links are similar to what have more often been referred to as associations. The advantage of the schematic representation in propositional networks is in depicting graphically the connections (associations) among the elements (ideas).

This representation of information in memory has a number of important features. First, propositions can be organized hierarchically. The argument Cadillac is an instance of a broader set of arguments for cars, and cars are know to bear certain properties such as the following: means of transportation, four-wheeled vehicle, driver-controlled, etc. Cadillac also is an instance of arguments for expensive objects. Similarly, the USSR is an instance of countries possessing a communist economy with which the United States, the country of which Nixon was President, has had considerable disagreements.

A second important feature of the propositional network is spreading activation, or the activation of additional concepts by evoking a single concept. When the label Cadillac appears, other associations with which it is

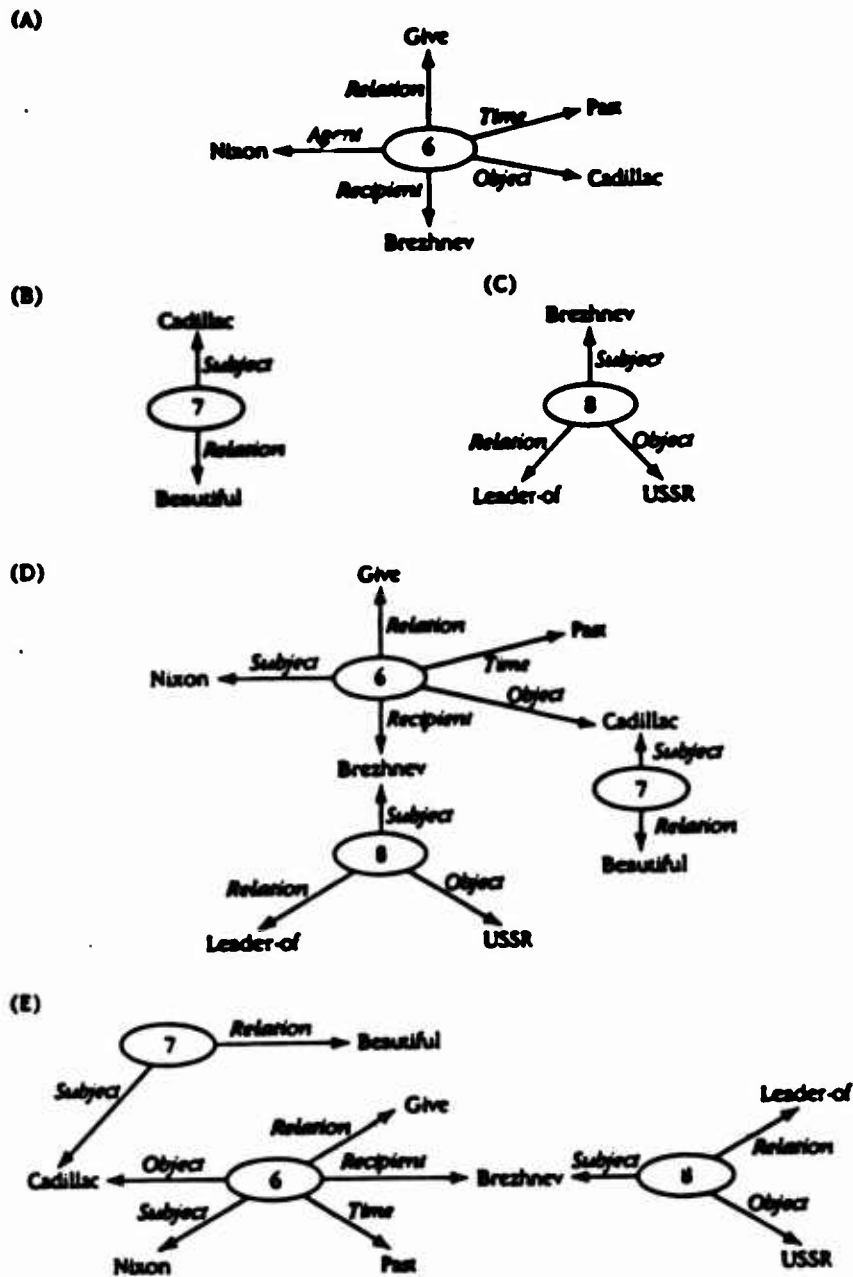**(A)**

(B)

(C)

(D)

(E)

Figure 1. Examples of propositional-network representations. A through C represent propositions 6 through 8. D illustrates the networks in A through C combined. E is another way of displaying the network in D.

Reproduced from Anderson (1985), p. 117.

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linked are activated, in addition to those identified in the sentence, as are
the other associations linked with Brezhnev. These hierarchies add informa-
tion to the meaning of the sentence and may be used in understanding how the
individual responds to the proposition. Giving an expensive vehicle to the
leader of a country that is in disagreement with the United States may be seen
as questionable. Thus, the sentence may produce a raised eyebrow of curiosity
that might not have appeared had Nixon given the Cadillac to the leader of a
country known to be on friendly terms with the United States. The important
point is that these associations reside in the listener rather than in the
sentence being communicated, are linked hierarchically to the initial concept,
and are activated depending on their relationship in the propositional network
to the initial concept. Anderson suggests that working memory is defined as
the range of nodes reached by spreading activation.

Larger units of meaning than can be represented by propositional net-
works require schema, or a configuration of interrelated features that define
a concept. The features or attributes used to define the concept wheel (as in
tires for a car) may consist of the following interconnected list:

superset:	object which rolls
material:	rubber tire, mounted on metal inner wheel
contents:	air
function:	movement
shape:	round, doughnut like
size:	6"w x 27"d to 8"w x 36"d (approx.)
location:	on axle of car

The schema for a wheel therefore consists of the specific values that a
wheel has on these and perhaps other attributes. Schemas may be composed of
propositional networks but differ from propositional networks in two ways.
First, any of the attributes in a schema may take on different values. For
example, the concept wheel would be linked hierarchically within the superset
object which rolls to the concepts ball and cylinder, each of which has its
own values on the features indicated. Second, networks in schemas are inter-
connected with other networks. Each of the values specified for wheel has its
own attributes that link it hierarchically to other concepts, as the concept
air is linked to oxygen, hydrogen, and nitrogen.

The principal value of schemas is that they facilitate making inferences
about concepts. If we hear the concept wheel, and the reference clearly is to
the tires on a car, we understand that the wheel is round, is made of rubber,
and other features specified in the hierarchical organization. This infer-
ential process is based on probabilities in that the wheel size may be sub-
stantially different if the car is a go-cart or a grand prix racer. Stated
differently, the value of schemas is that they enable us to organize and
understand new information. Upon hearing the word wheel, we can juxtapose the
concept relative to other important and related concepts and thereby develop a
broader understanding than is evident from the information supplied by any
sentence.

New events tend to be encoded with respect to schemas, and schemas in-
fluence subsequent recall. Schemas are used to infer information that is
missing in recall. The probabilistic nature of schemas indicates that recall
will be accurate providing that the inferences match the situation but will be

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inaccurate if the inference and the situation fail to match. Thus, schema may either assist or detract from accurate recall.

Applications to Second Language Acquisition. At least three sets of questions concerning second language acquisition are raised by Anderson's discussion of declarative knowledge in memory. These questions concern (a) how meaning in two languages is represented in memory, and how the transfer of L1 knowledge to L2 expression takes place; (b) whether some types of knowledge are more easily transferred to the L2 than others; and (c) how metalinguistic information is stored and influences performance for bilinguals.

In second language acquisition, theorists have argued whether bilingual individuals have two separate stores of information in long-term memory, one for each language, or a single information store accompanied by selection mechanisms for using the first (L1) or the second (L2) language (McLaughlin, 1984). If individuals have a separate store of information maintained in each language, they would select information for use appropriate to the language context or the language being used at the time.

Transfer of information acquired in L1 to L2 applications would be difficult because of the independence of the two memory systems. An individual at the early stages of proficiency in L2 would either have to translate information from L1 to L2, or relearn the L1 information in L2, capitalizing on existing L1 knowledge where possible. In Anderson's theory, information in either L1 or L2 has a meaning-based representation and would be stored as declarative knowledge through either propositional networks or schema.

The existence of separate propositional networks and schema associated with each language is consistent with the notion of domain-specific language skills. Speakers of L1 often acquire vocabulary and structures for specific domains appropriate to interactions in their profession, family, social group, or shopping place. The domain-based meanings represent schema in that unique concepts, linkages, propositions, and networks are involved in each domain. Learners may acquire one or more of these domain-specific capabilities in the L2 by direct exposure or by training but be ineffective in communicating in other domains because of the highly specific nature of the language involved. Thus, domain-specific language proficiency may be constructed out of experience and not established by direct transfer from L1 proficiency.

Cummins (1984) proposes a common underlying proficiency in cognitive and academic knowledge for bilinguals. He urges that what is originally learned through the L1 does not have to be relearned in the L2, but can be transferred and expressed through the medium of the L2. Cummin's view of a common underlying language proficiency seems to be supported by Anderson's suggestion that nodes are based on meaning rather than a direct replication of language. Nodes which access meaning in long-term memory may be nonlanguage-specific but also have built-in features that signal one language or the other, as McLaughlin (1985) has suggested. In other words, the selection of L1 or L2 for comprehension or production is performed in short-term memory, whereas concepts are stored in and retrieved from long-term memory as nonlanguage-specific generalized meaning. L2 learners may be able to transfer what they already know from the L1 into the second language by (a) selecting L2 as the language for expression, (b) retrieving information originally stored through the L1 but presently existing as nonlanguage-specific declarative knowledge,

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and (c) connecting the information to the L2 forms needed to express it. The first and third steps would be functions that occur in short-term memory. In fact, learning strategy research (O'Malley et al., 1985a) indicates that students of English as a second language consciously and actively transfer information from their first language for use in L2.

A second question raised by Anderson's theory is whether there is variation in the effectiveness or ease of transfer of declarative knowledge from the L1 to the L2. Is all declarative knowledge originally acquired in an L1 context equally easy to transfer and access through the L2, or do the characteristics of the declarative knowledge make a difference? Anderson's descriptions of the way in which declarative knowledge can be represented in memory provide clues to the answer to this question.

Anderson indicates that declarative knowledge may be represented in memory as schemas, or organizational frameworks. He describes two major types of schemas, organization by natural categories and organization by events. Natural category schemas are based on real world phenomena, such as classifications of plants, animals, minerals, quantities, and other aspects of the natural world. A natural category schema would appear to be easily transferable to expression through a second language because the information describes observable reality. (This assumes that the person has learned about natural phenomena from a scientific rather than a naive point of view, since the latter may not always be correct.)

Schemas organized by events include both personal recollections of event sequences and the sequence of events that characterize the discourse organization of a story. Story scripts (or story grammars) have been shown to be strongly influenced by culture. For example, in Western culture, stories traditionally deal with a hero who sets out to accomplish a definite goal. By accomplishing the goal, he or she attains a reward, which is often material. In traditional Japanese stories, on the other hand, the protagonist is not goal oriented and adventures and rewards that come about do so as a result of the protagonist's intrinsic merit (Matsuyama, 1983). Second language learners who have internalized one type of story schema may find it difficult to understand a differing schema not because of language factors but because of cultural expectations.

Another type of event organization described by Anderson (1980) is referred to as social cognition. Persons organize their knowledge about individuals or groups according to certain perceived characteristics. This type of schematic organization of knowledge may lead to stereotyping, because one person's individual knowledge about a group may rely on data limited to personal experience or biased information. The formation of stereotypes may also be culturally linked, so that the schema developed to characterize a certain group through the L1 may not be relevant to characterize the same group through the L2. A stereotype transferred to a second language context may interfere with accurate communication in the L2.

Thus, the way in which declarative knowledge is organized in memory may have a substantial effect on the L2 learner's ability to transfer it effectively and accurately into the new language. The educational implications for second language learners are that concepts related to natural categories such as science, mathematics, and technical subjects may be easier to transfer to

the L2 than are concepts related to culturally affected areas such as litera-
ture or social studies, or concepts related to domain-specific knowledge.

A third question raised by Anderson's views on declarative knowledge is
how metalinguistic information among bilingual persons is stored and how this
information influences performance. One of the primary features defining
metalinguistic awareness is an understanding of the arbitrary uses of language
(Miller, 1956). Bilinguals may be expected to have an advantage in under-
standing arbitrariness in language use and, accordingly, in metalinguistic
awareness (De Avila & Duncan, 1979). Metalinguistic awareness will be mani-
fested particularly in fluent bilinguals, and these individuals will have
advantages not only in verbal skills but in problem solving tasks (Tunmer,
Pratt, & Herriman, 1984)., Bilingualism has been viewed as a "three-
dimensional insight" into language that a monolingual rarely experiences
(Lambert, 1981). Advantages found among bilinguals have included enhanced
concept formation and mental flexibility, as in the ability to switch object
names and to use the new names in sentences (Cazden, 1972; Feldman & Shen,
1971; Ianco-Worrall, 1972).

Metalinguistic awareness may be described in part in Anderson's theory as
a new schema constructed to link schemata in L1 and L2 that reference the same
domain. That is, an individual with domain-specific knowledge in two lan-
guages may begin to see the different ways in which concepts can be expressed
in L1 and L2. The person then establishes a new schema that differentiates
applications of each language to identical concepts. This explanation of
metalinguistic awareness presumes that separate memory systems are developed
in each language.

Cummins (1979) notes that the cognitive benefits of bilingualism may
depend upon children reaching a minimum level of bilingualism (his "threshold"
hypothesis), and that the level of competence achieved in the L2 may depend
upon the proficiency of the child in L1 at the time when intensive exposure to
the L2 begins (his "interdependence" hypothesis). In Anderson's terms, sche-
mata linking knowledge based on independent language systems would not have
sufficient connections to establish metalinguistic awareness unless Cummins'
threshold and interdependence conditions are met. Failure to meet Cummins'
two conditions could also detract from the ability to transfer information
from the L1 to L2 in that schema established in L1 may not have sufficient
internal linkages to provide an adequate foundation of information.

Procedural Knowledge. The term "cognitive skill" is used by Anderson
(1980) to refer to the ability to perform various mental procedures. Our
ability to understand and generate language or apply our knowledge of rules to
solve a problem would be examples of procedural knowledge. Anderson argues
that as we use the same knowledge over and over again in a procedure, we can
lose our access to the rules that originally produced or enabled the proce-
dure, and thus lose our ability to verbally report or "declare" these rules.
An example of the distinction between declarative and procedural knowledge in
the context of second language acquisition is the following, from Anderson
(1980):

> When we learn a foreign language in a classroom situation,
> we are aware of the rules of the language, especially just
> after a lesson that spells them out. One might argue that

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our knowledge of the language at that time is declarative.
We speak the learned language by using general rule-
following procedures applied to the rules we have learned,
rather than speaking directly, as we do in our native lan-
guage. Not surprisingly, applying this knowledge is a
much slower and more painful process than applying the
procedurally encoded knowledge of our own language.
Eventually, if we are lucky, we can come to know a foreign
language as well as we know our native language. At that
point, we often forget the rules of the foreign language.
It is as if the class-taught declarative knowledge had
been transformed into a procedural form. (p. 224).

Because not all second language acquisition occurs initially in class-
rooms, and not all second language classrooms focus on grammatical rules, the
rules followed by a beginning learner may not be easily identifiable rules of
"grammar," but may emerge out of the individual's communicative experiences,
and thus represent an ad hoc usage rule. Regardless, whereas declarative
knowledge or factual information may be acquired quickly, procedural knowledge
such as language acquisition is acquired gradually and only with extensive
opportunities for practice. The representation of procedural knowledge in
memory is a key issue in cognitive theory and is contained in what Anderson
(1983, 1985) refers to as production systems.

Production Systems. One of the problems in developing an effective and
useful theory of cognitive skill acquisition has been understanding and ex-
plaining how complex cognitive skills are represented in human memory.
Anderson (1983) argued for a unitary theory of the mind or a common cognitive
system for all higher-level mental processes. This position is in direct
contrast to the opinion of many theorists, including Chomsky (1980), who argue
for viewing the mind as having specific faculties associated with language and
perhaps with other special symbolic systems such as numbers.

Recently, artificial intelligence has made an important contribution to
cognitive psychology by developing sets of procedural formalisms that serve as
models of how complex cognitive skills can be represented in memory using
uniform principles of representation. One such representational system, a
production system, is briefly described here. Anderson argues that all com-
plex cognitive skills can be represented as production systems. Computer
simulations using production systems have been developed for a number of
cognitive skills--including such seemingly diverse skills as reading
(Thibadeau, Just, & Carpenter, 1982), playing chess (Newell & Simon, 1972),
and algebra problem solving (Bobrow, 1968). In its most basic form, a pro-
duction has a "condition" and an "action." The condition contains a clause or
set of clauses preceded by IF, and the action has a clause or set of clauses
preceded by THEN. Consider, for example, the following production for plural-
ization, from Anderson (1980):

IF the goal is to generate a plural of a noun,
and the noun ends in a hard consonant,
THEN generate the noun /s/.

Note that one of the conditions for this production refers to an internal
goal. This is an important point because as internal goals or states change

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or are satisfied for the learner, the IF clause will match different sets of stored conditions and the learner will execute different sets of actions. Condition-action pairs (or productions) such as this one can initially be represented in declarative form, and gradually, through practice, can be compiled into production sets and fine-tuned to the point of automatic execution. Such a representational system can be used to represent specific procedures in any domain (math, physics, chess, language, and so on) as well as general strategies or domain-independent problem solving procedures. Moreover, the relationships among elements of a skill can be clearly specified, and the conditions that must exist for a particular skill to operate can be made explicit (see Gagne, 1985 for a discussion of production system notation in the representation of basic skills).

Applications to Second Language Acquisition. The distinction between declarative knowledge and procedural knowledge has both theoretical and practical importance in second language acquisition. Knowing about language as a grammatical system, which involves knowing the rules underlying syntax, semantics, and phonology, is not a sufficient condition for knowing how to use the language functionally, as many teachers and students of foreign languages have discovered. In order to use a language for communicative purposes, procedural knowledge is required. In second language acquisition, Canale and Swain (1980) define the four components of communicative competence as the ability to use grammatical, sociolinguistic, discourse, and strategic skills. In order to develop this type of competence in a second language, instructional approaches need to provide for communicative activities which focus on language as a skill rather than on language as an object of study.

In applying production systems to second language learning it is important to consider the idea of rule in its broadest sense. Rules may apply to all aspects of a language and are not limited to systematic rules of grammar. Table 1 is an example of a production set that illustrates some of the different types of rules that need to be applied by the second language learner in order to be communicatively competent, as communicative competence is defined by Canale and Swain (1980). Specific examples are presented of rules covering sociolinguistic competence, discourse competence, and strategic competence. Thus, rules of grammar are only a part of the declarative knowledge required by a competent user of the second language. By using production system notation, additional aspects of language use can be specified and described. Table 1 shows how a production system might be used to generate and maintain a particular conversation in a second language between an intermediate level speaker of English and a native English speaker. The purpose of this example is to illustrate how even a brief conversational exchange is subject to complex rules on a number of aspects of language, of which grammar is only one.

The example in Table 1 illustrates the goal-directed characteristics of communication interactions and the adaptability of goals as the conversation progresses. Although only one set of goals is illustrated, the speaker may change goals and move the conversation in different directions or even exit from the conversation at any time. In this example, the speaker restates portions of the communication that were misunderstood by the listener. The intent to communicate begins at P1 where the speaker establishes a goal to communicate with another person in the speaker's second language. P2 identifies a subgoal to use the second language that leads to P3, which concerns

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selection of an appropriate greeting. Thus, goals may be embedded in other goals and provide connecting links in the production system. In P6 the speaker initiates the conversation by expressing the greeting and in P10 the listener responds by presenting a question. The exchange continues in P13 with the speaker's miscommunication in the second language. In P14 the speaker recognizes that a mistake has been made and in P15 tries to formulate the P13 utterance again. The phrase "pop the goal" is a convention used by Anderson (1983) to indicate that the sequence shifts from the current goal to one preceding it in the hierarchy. The communication continues at P18 where the listener initiates an extended story requiring attention by the initial speaker.

A general model of a conversation would contain multiple branching and exit opportunities in addition to a hierarchical structure with subroutines reflecting subgoals that depend on the choice made at a given branching opportunity. The choice selected at one turn determines the next production set, which then creates a new set of choices. For example, among the choices evident is the possibility of ending the conversation at any point. The native speaker of English has a number of gambits that can be used to end a conversation in a socially appropriate way, such as, "Well, I've got to go now," or, "Hey, it was great seeing you." Such discourse markers and their underlying meaning may be unknown or misunderstood by limited English proficient individuals, resulting in their inability to end a conversation appropriately or to recognize that the other person is ending the conversation. As a result, the limited English speaker may explore a number of possible meanings for such utterances before reaching an accurate conclusion. This exploration may require new production sets just to interpret the communication, each of which may have new goals and choices.

Individuals applying rules to a communication as described in Table 1 may do so efficiently despite the level of detail required to delineate individual steps in the interaction. The rules governing individual productions in some cases may be procedural rather than declarative knowledge and may have been forgotten by the person. Furthermore, as we will point out below, rules that are represented by procedural knowledge may be performed automatically without conscious deliberation, although some rules may still require conscious application in the production. Whether any single production is represented by declarative or procedural knowledge will most likely depend on the learner's prior exposure to rule systems in instruction, the transfer of comparable rules from L1, and the person's prior opportunities for communicative practice in contexts where sociolinguistic and strategic competence are needed.

Stages of Skill Acquisition

The important question which follows from the description of procedural knowledge in Anderson's theory is "How does one proceed from the rule-bound declarative knowledge used in performance of a complex skill to the more automatic proceduralized stage?" Anderson (1983, 1985) described three stages of skill acquisition: the cognitive, associative, and autonomous stages.

Table 1

A Production System for Communicating in a Second Language

P1   IF the goal is to engage in conversation with Sally,
THEN the subgoal is to use my second language.

P2   IF the goals is to use my second language,
THEN the subgoal is to initiate a conversation.
(sociolinguistic competence)

P3   IF the goal is to initiate a conversation,
THEN the subgoal is to say a memorized greeting formula.
(discourse competence)

P4   IF the goal is to say a memorized greeting formula, and the
context is an informal one,
THEN choose appropriate language style.
(sociolinguistic competence)

P5   IF the goal is to choose an appropriate language style,
THEN the subgoal is to say: "Hi, how's it going, Sally?"
(sociolinguistic competence)

P6   IF the goal is to say: "Hi, how's it going, Sally?"
THEN the subgoal is to pay attention to pronouncing the sentence
as much like a native speaker as possible.
(grammatical competence for pronunciation)

P7   IF the goal is to pronounce the sentence as much like a native
speaker as possible,
THEN the subgoal is to check whether my pronunciation is accurate
enough to communicate my meaning.
(sociolinguistic competence)

P8   IF the goal is to check whether my pronunciation is accurate
enough to communicate the meaning of my greeting,
THEN the subgoal is to pay careful attention to Sally's response.
(sociolinguistic competence)

P9   IF the goal is to pay careful attention to Sally's response, and
her response indicates that she has understood my greeting,
THEN the subgoal is to wait for Sally to finish her conversational
turn.
(discourse competence)

P10   IF the goal is to wait for Sally to finish her conversational
turn, and she completes her turn with a question,
THEN the subgoal is to understand her question.
(grammatical competence)

Table 1 (Continued)

P11   IF the goal is to understand Sally's question,
       THEN the subgoal is to compare what she says to what I already know
       in English and to my general knowledge about how conversations work.
       (grammatical competence and sociolinguistic competence)

P12   IF the goal is to compare Sally's question to what I already know,
       and the match is good enough for me to understand her meaning,
       THEN the subgoal is to answer with the information requested.
       (discourse competence)

P13   IF the goal is to answer with the information requested, and I want
       to form a grammatically correct sentence,
       THEN the subgoal is to pay attention to word order and noun and
       verb endings as I respond.
       (grammatical competence for syntax and strategic competence)

P14   IF the goal is to pay attention to word order and noun and verb
       endings, and I notice (or Sally's reaction makes me notice) that
       I have made a mistake that impedes comprehension,
       THEN the subgoal is to correct my mistake.
       (sociolinguistic and grammatical competence)

P15   IF the goal is to correct my mistake,
       THEN POP the goal (e.g., go back to P13).

P16   IF the goal is to continue the conversation with Sally, and she
       responds with a question that I don't understand,
       THEN the subgoal is to ask her to repeat or paraphrase.
       (strategic competence)

P17   IF the goal is to ask Sally to repeat or paraphrase her question,
       and this time I understand the question,
       THEN POP the goal (e.g., go back to P12).

P18   IF the goal is to continue the conversation with Sally, and she
       begins telling a long story about her activities,
       THEN the subgoal is to pay attention to her pauses and linguistic
       markers and interject comments appropriately.
       (discourse competence and strategic competence)

Cognitive Stage. For most learners, skill learning begins with the cognitive stage. During this stage, learners are either instructed how to do the task or attempt to figure it out and study it themselves. This stage involves conscious activity on the part of the learner, and the acquired knowledge at this stage is typically declarative and can be described verbally by the learner. For instance, one can memorize vocabulary and the rules for grammar when learning to speak a second language, or when to use an unanalyzed chunk of language appropriately, just as one can memorize any other set of facts. This knowledge enables one to describe how to communicate in the second language, but the knowledge by itself is inadequate for skilled performance.

Associative Stage. During this second stage, two main changes occur with respect to the development of proficiency of the skill. First, errors in the original declarative representation of the stored information are gradually detected and eliminated. Second, the connections among the various elements or components of the skill are strengthened. During this stage, declarative knowledge is turned into its procedural form. However, the declarative representation initially formed is not always lost. Thus, even as we become more fluent at speaking a foreign language, we may still remember the rules of grammar. Performance at this stage begins to resemble expert performance, but may still be slower and errors may still occur.

Autonomous Stage. During the third or autonomous stage, the performance becomes increasingly "fine-tuned." The execution or performance of the skill becomes virtually automatic and errors that inhibit successful performance of the skill disappear. The skill can often be executed effortlessly, and there is much less demand on working memory or "consciousness" at this stage. Thus, as we become skilled drivers, we shift gears smoothly and automatically, without consciously applying rules. In fact, skilled drivers are typically able to drive and carry on a conversation at the same time, indicating that very little conscious processing is being devoted to driving. The skill has become automatic and the driver is able to monitor its effective execution with very little effort. Similarly, as we become more proficient in a second language, we are able to comprehend and produce utterances with little difficulty. It is important to note that skilled performance improves gradually. While a fact can often be learned in one trial, a skill can only be mastered after a relatively long period of practice.

Applications to Second Language Acquisition. Anderson's (1980) three stages of skill acquisition have important implications for understanding the process of second language acquisition and for developing an instructional approach that is congruent with this process. At least four issues in second language acquisition can be examined through the theory of cognitive skills acquisition: (a) the parallel between stages and second language constructs; (b) the learner's awareness of learning processes; (c) the rate of language acquisition for selected learning tasks; and (d) the relationship between level of skill acquisition and language retention over time.

The parallel between stages and second language constructs can be shown by delineating second language processes occurring at each stage. During the cognitive stage, the second language learner engages in conscious mental activity in order to find meaning in the new language. This conscious mental activity may focus on different aspects of the L2, depending on the context of learning. The learner's attention may focus on the functional use of language

in what has been called a "natural" acquisition environment, or learning that takes place informally outside the classroom (Krashen, 1982). Learners in these contexts have been observed to respond to and use appropriately entire phrases or sentences whose component parts are not yet understood (Ventriglia, 1982). For example, a learner might be aware of the functional consequences of "Heygimmedeball" and even note that it has similarities with "Heygimmedepencil" but be unaware of the grammatical components involved in the continuous string of sounds. In a sense, learners are opportunistic and grasp meaningful chunks of language that they can understand and that appear to have important consequences. In a classroom setting, on the other hand, the learner's attention may be directed by the teacher to the formal aspects of the language, to its sound system, to vocabulary, to functional use of language chunks in communicative activities, or to a combination of these aspects of language. Whatever the characteristics of the input are, however, the learning process at the cognitive stage would be the same--intensive attention to the new language and deliberate efforts to make sense of it.

The intensive attention to the new language that characterizes the cognitive stage may explain why many learners go through a silent period or delay language production at the beginning of their exposure to the L2 (Krashen, 1980). Beginning level learners may find it easier to focus on understanding and remembering different parts of the new language by silently attending to it rather than being distracted by the demands of immediate language production.

In the second, or associative stage of skill learning, learners begin to develop sufficient familiarity with the knowledge acquired in the first stage so that it can be used procedurally. This stage appears to correspond with what second language theorists term interlanguage, the not-yet-accurate use of the target language by the L2 learner (see Selinker, 1972; 1984). Interlanguage is characterized by errors which are gradually corrected as learners become more proficient at detecting discrepancies between their language production and the models that they encounter. Interlanguage is a temporary system that is restructured as the learner tests hypotheses about the new language, and adds, drops, or modifies rules as a result of these trials. At this intermediate stage the L2 learner is able to use the language for communication, although imperfectly, but may find difficulties in using the new language as a tool for learning complex information because active attention is still being given to strengthening the language skill itself, and this reduces the amount of attention that is free to deal with incorporating new information into declarative knowledge.

When second language learners reach Anderson's third stage of language learning, they are able to process language autonomously. In other words, their performance in the language is very like that of a native speaker. In second language acquisition, this third stage has been called automatic processing (McLaughlin et al., 1983). At this point the learner focuses on using the language for functional purposes, whether these are social, academic, or technical. Because language can be processed autonomously, the learner is able to process new information at the same time that language is in use. In other words, parallel processing becomes possible.

The second issue that can be analyzed using a cognitive theory of skill acquisition concerns conscious awareness of learning. The internal processing

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that takes place during these stages may explain the role of conscious learning effort in different language contexts. Krashen (1982) uses the term "acquisition" to refer to language proficiency gained through unconscious processes in unstructured language interactions outside the classroom, and "learning" to refer to language skills gained through conscious processes in the structured environment provided by classrooms. In the cognitive theory of complex skill acquisition, all second language learners at the initial stages are consciously aware of learning processes. Learners in unstructured language contexts might be more inclined to process language into chunks based on meaning or language functions rather than the formal language structures presented in some second language classrooms. The learner tends to be consciously aware of these rule applications (whether the rules are formal or intuitive) during initial stages of acquisition, and unaware of rules once proficiency has been achieved.

Thus, where linguistic theory predicts unconscious learning, cognitive theory predicts awareness. Evidence supports the view that beginning and intermediate L2 learners are aware of strategies used outside the classroom as well as those used in school settings (O'Malley et al., 1985a). Further, where linguistic theory differentiates between acquisition and learning, cognitive theory sees the distinction as unnecessary and unparsimonious. Because different language skills may be acquired at different rates, as pointed out below, a learner might be unaware of conceptual processing for more advanced individual skills even though overall proficiency is at the beginning or intermediate level. Language processing without awareness therefore could occur in either classroom or nonclassroom settings depending on the level of the skill. Analysis of the cognitive processing that goes on even in unstructured learning environments provides opportunities to understand language acquisition in more generalizable terms parallel to other complex skills. A cognitive model of language learning sees active conscious processes involved in all language settings, at least in the initial stages of learning. These processes can be described and used to assist learning instead of relegated to the uncertainty of unconscious mechanisms.

The third issue that can be examined with a theory of skills acquisition is the rate and type of language skill acquired. Given that language is a highly complex system, involving not only grammar, semantics, and pronunciation, but also rules of usage and discourse, learners may acquire different aspects of the new language sequentially. For instance, a learner might move through the three stages of skill acquisition initially with those aspects of the new language that are most accessible. For some learners, this might be the sound system or grammar rules. For others, it might be sociolinguistically appropriate chunks of the new language, and for others it might be communication tricks which keep a conversation going. As these "easy" features move from the cognitive stage through the associative stage and then become autonomous, the learner begins to have more and more attention freed to focus actively on some of the "harder" features of the new language as well as content information through the medium of the new language.

The relative difficulty of different language features could serve as a basis for chunking with L2 learners. Individuals might treat a difficult chunk with rule-based procedures that are applied at the cognitive stage while processing what is perceived as easier language using procedures at the associative or autonomous stage. Thus, a learner might alternate processing

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associated with different stages of learning depending on the perceived difficulty of language chunks. What is perceived as easy or difficult could vary between learners, and might depend on factors such as age, context of learning, learning style, affective considerations, prior declarative or procedural knowledge, and ability to deploy effective learning strategies.

A fourth issue that a cognitive theory of skill acquisition can address is the retention or attrition of a second language after formal instruction ceases. Research on language attrition indicates that both the initial competence gained in a second language and the amount of subsequent practice opportunities affect how much of the language is lost or retained over time (Lambert & Moore, 1984; Oxford, 1982). Research on second language attrition has attempted to identify which aspects of a language are forgotten and if the sequence of forgetting parallels the initial learning sequence. A cognitive theory of skills acquisition would predict that aspects of the language that are at the first or cognitive stage of acquisition and are therefore represented by declarative knowledge would be forgotten first, whereas those aspects of the language that have become automatic or proceduralized would be retained. The issue that needs to be addressed is, which language skills are declarative and which skills are procedural? Vocabulary is identified with concepts, and thus can be represented as declarative knowledge. Sociolinguistic competence involves knowing about cultural norms, styles, and registers, and may also be represented as declarative knowledge. In contrast, grammatical competence--whether phonological, morphological, or syntactical--is characterized in Anderson's (1980) theory as procedural knowledge. Strategic knowledge, or competence in deploying strategies to assist communication, may also be procedural knowledge. While the distinction between declarative and procedural knowledge drawn here with specific language skills may vary depending on the learner, the general implication is that the way in which knowledge is represented will influence retention. The distinction may be useful in planning the types of skills on which relearning in a second language should be focused, and the types of learning activities that should be emphasized during initial instruction.

In summary, viewing second language acquisition as a cognitive skill offers the following advantages: (a) it can provide a comprehensive and well-specified theoretical framework for second language learning, (b) it can be adapted to provide a detailed process view of second language acquisition and retention, and (c) it can help to identify and test the existence and applicability of specific learning strategies that are appropriate at various stages in second language development. In the next section we examine the process of listening comprehension in the context of Anderson's theory of cognition.

LISTENING COMPREHENSION

The view that language is manifested as procedural knowledge follows from the position that language can be described as a cognitive skill. One advantage of this view is the applicability of findings regarding complex cognitive skills to second language acquisition. In the foregoing discussion, stages of skill acquisition were seen to parallel stages in which language is learned, and production systems were used in describing procedures for generating language. In this section, we elaborate on the use of production systems by

illustrating their applications to second language comprehension within the context of Anderson's three-stage theory of comprehension processes. We selectively draw on Anderson's theoretical developments to illustrate applications to second language comprehension, and point out some critical comprehension processes that Anderson does not address.

Comprehension Processes

Anderson (1985) indicates that listening comprehension can be analyzed into three stages: perceptual processes, parsing, and utilization. In the first stage, perceptual processing, the acoustic message is encoded as attentional processes focus on the oral text. In the second stage, parsing, words and messages are transformed into meaningful mental representations. The third stage, utilization, consists of relating a mental representation of the text meaning to existing knowledge. In the utilization stage, Anderson differentiates between aspects of messages that are assumed by speakers to be known by the listener and parts that are assumed to be new to the listener.

Perceptual Processing. Two essential aspects of perceptual processing in language comprehension are attention and speech recognition. Attentional processes in most recent theory have been characterized as limited in both scope and capacity (e.g., La Berge & Samuels, 1974; Shiffrin & Schneider, 1977). Limitations in scope are evident in the inability of listeners to focus simultaneously on more than one demanding task. For instance, when students report being able to study while watching TV, at least one of these tasks is not cognitively demanding for the individual. On the other hand, the typical person finds difficulty in simultaneously performing two addition problems, or holding two conversations at the same time. Limitations in the capacity of attention are evident in the inability of listeners to retain more than a modest amount of information from the total input to perceptual awareness. Listeners and readers must actively process information being communicated in order to retain important elements in a spoken or written text. The mental processing that occurs is described below under the section on parsing.

The demand on attention is alleviated when at least one of the tasks being performed is highly practiced. This has led to speculation about the existence of automatic processes, or processes that require little attention, and controlled processes or processes that require extensive attention. Automatic processes are involved in such well practiced activities as driving a car, typing, and using one's native language, while controlled processes are involved in the initial stages of acquiring a skill, or in performing certain tasks that may be performed infrequently, such as speaking a foreign language. Parallel processing appears to be possible when at least one of the tasks involves automatic processing, as in driving and having a conversation on a demanding topic.

The second aspect of perceptual processing in language comprehension is speech recognition. This process involves segmentation or the differentiation of speech components into meaningful elements. These elements vary in complexity and include phonemes, words, phrases, propositions, and sentences. While Anderson does not say so directly, the listener's selection of a unit size for segmentation probably depends upon his or her knowledge of the

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language, general knowledge of the topic, and how the information is presented (Richards, 1983). A listener attending to a difficult oral text might look for the smallest segment that can be handled conceptually, while a listener attending to a more manageable text might find it more appropriate to focus on larger units. Thus, an expert or proficient speaker of a language would probably be able to identify larger chunks of meaning in an extended oral text than would a novice at the language.

Applications to Second Language Acquisition. In the perceptual processing stage of language comprehension, the L2 learner focuses on the acoustic features of a continuous stream of speech. In the beginning stages of acquisition, the learner may not be able to distinguish between word and phrase boundaries. As the L2 learner becomes more proficient, speech recognition becomes more automated, allowing the learner to attend increasingly to meaning-related aspects of the speech comprehension process. Throughout these successive stages of proficiency development, three factors influence perceptual processing: (a) the interaction of context and speech, (b) comprehension processing preferences, and (c) learner motivation.

The first of these influences on perceptual processing, the interaction of context and speech, is manifested through cues the listener depends on for meaning. Listeners may apply either general world knowledge to information contained in the oral text (top-down processing), or use syntactic information to derive meaning (bottom-up processing). In second language acquisition, world knowledge acquired in an L1 context may not be as easy to access for comprehension purposes in L2 because the listener may be able to reach it only through the L1. The interaction of context and speech features, in Anderson's (1980) view, facilitates encoding new information because the context indicates which features have priority. For the beginning level L2 learner, however, the context cannot be easily accessed because a sufficient context has not yet been developed in the L2. Further, the existing context developed in the L1 may not match the intended context of the message listened to in the L2 (or the listener may not be able to make a link to a shared context between the two languages). In such a case, the L2 listener might find it impossible to prioritize which features to focus attention on during a listening task. This could explain why L2 students say that at a certain moment in listening they just tune out - they are trying to attend to all features of the incoming message and have no strategies for focusing their attention on the most informative features that would, if stored, make the greatest contribution to getting the meaning of the speech stream.

The second influence on perceptual processing consists of comprehension processing preferences. L2 learners may have preferences in comprehension processing approaches that are attributable to individual differences or to differences in proficiency level. Ventriglia (1982), for example, describes three types of preferred initial language learning styles: beaders are semantic processors who focus on learning one word at a time; braiders learn language patterns and chunks; and orchestrators process incoming language on the basis of its phonological characteristics. Byrnes (1984) identifies two types of second language learners, those who value fluency and those who value accuracy. In terms of listening comprehension, learners concerned with fluency try to get the main ideas of the text by attending to the context and picking out key words. On the other hand, learners concerned with accuracy rely on their knowledge of grammar to understand an oral message and proceed

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by attending to individual features. Conrad (1985) found differences in listening comprehension strategies that were related to proficiency level. Less proficient students concentrated on processing syntactic information at the sentence level, whereas more proficient students processed the message primarily on a semantic basis on the level of extended text.

The third influence on perceptual processing is affective factors. Dulay and Burt (1977) and Krashen (1982) have hypothesized that an _affective filter_ can have an adverse effect on a second language learner's ability to make use of language input. Students who experience anxiety or negative attitudes towards the new language are said to have a high affective filter which inhibits second language acquisition. A more precise understanding of the nature of this type of affective inhibitor can be gained by relating it to cognitive theory which identifies the limitations of attention (Anderson, 1980). In the presence of an affective inhibitor, the second language learner has less attention available to direct to the incoming language.

An issue that is related to these affective concerns is the influence of motivation on learning a second language. In the second language acquisition literature, considerable significance has been attached to social processes that enhance or detract from motivation (e.g., Cummins, 1986; Gardner, 1979; Schumann, 1984; Wong-Fillmore & Swain, 1984). As Lambert (1981) notes, learners can benefit substantially from favorable attitudes, orientations, and motivation. However, inducements to promote motivating circumstances provide no specific formulations to assist learners in processing new information in L2. There are two important points at which cognitive research suggests that concentrated effort by learners can influence learning. The first is in attentional processes, where learners can remind themselves to attend to new information (Weinstein & Mayer, 1986), or to attend selectively to important features of the new information (O'Malley et al., 1985b). The second point where motivation influences learning is in processing strategies, where more highly motivated individuals appear to process new information more effectively (Anderson, 1985). Specific strategies for processing in listening comprehension are discussed further in sections below on parsing and utilization.

Parsing. Anderson (1985) indicates that we are able to progress from hearing a string of words to comprehension of meaning because language is structured according to a set of rules. The rules are evident in the surface structure of sentences. The rules may be based on the conventional rules of grammar such as the following:

> Upon hearing the sequence _noun, verb, noun_ (the bat hit
> the ball) the listener understands that the first noun has
> a relation to the second noun that is specified by the
> verb.

> Upon hearing the sequence a _noun_ was _verbed_ by a _noun_ (the
> ball was hit by the bat), the listener understands that
> the second noun has a relation with the first noun that is
> specified by the verb.

Most importantly, the rules may also be based on meaning as represented in _parsing productions_. These productions are identical to the production system

condition/action sequences discussed earlier and may be assembled into prop-
ositional networks. The condition (IF) of each production specifies the word
pattern, and the action (THEN) identifies the associated meaning that is
stored in memory. They are similar to the rewrite rules that are used to
generate the surface structure of a sentence in transformational grammar.
Larger units of meaning such as sentences and paragraphs have a seemingly
infinite variety of ways in which language can be composed, however, and are
difficult to organize according to rules. Listeners probably look for recog-
nizable parsing production patterns within sentences and combine recognized
patterns to derive and store meaning in memory. Thus, more complex oral texts
may require concatenation of basic parsing productions in order to be
understood.

Parsing productions are successful in oral text because sentences contain
clues that allow the constituents to be identified. The primary cue for seg-
mentation or chunking a string into phrases is meaning. Cues to meaning may
be represented in syntax, word order, key words, inflections, and pauses
(Anderson, 1983; 1985). One of the reasons that individuals may have diffi-
culty in understanding spoken language is that they are unfamiliar with the
rules for chunking. Extended oral text in the L2 will appear to be a contin-
uous stream of undifferentiated sounds to the listener who is unable to chunk
into meaning-based words or phrases. Limitations in the scope and capacity of
short-term memory are important at this point. The listener's attention will
be consumed in looking for elements to chunk and have little remaining capa-
bility to interpret or retain what modest L2 information is related to world
knowledge. Further, as Rivers and Temperly (1978) note, because short-term
memory in L2 is often overloaded, words may be lost before they can be or-
ganized and interpreted. Thus, even though a listener might be able to
recognize individual words in a sentence, the person is unable to hold ex-
tended oral texts in mind long enough to process them (Call, 1985). The
difficulty of listening for comprehension when meaning is not evident can
exhaust the resources of the listener and lead to inattention.

Two factors suggest meaning is more important than formal linguistic
rules in listening comprehension (Richards, 1983). One is the clausal basis
of spoken language, that spoken language is usually delivered one clause at a
time. A second is the frequent use of ungrammatical forms in spoken language.
While the primary cue for segmentation seems to be meaning, the interpretation
of meaning is also directly related to text structure. As will be discussed
below in the section on utilization, text structure has a strong influence on
the comprehension of written text and probably of oral texts.

One of the critical processes involved in comprehension that Anderson
does not address completely is monitoring, or reviewing whether or not an
ongoing communication is understood. Monitoring is mentioned incidentally in
the production system theory (Anderson, 1983) as a feedback process derived
from productions which result in overt behavior. Feedback regarding the
consequences of an action may be external if provided by another person or
internal if it results from comparison of an actual consequence with an
expected consequence. This definition of monitoring is somewhat different
from internal monitoring to detect comprehension but nevertheless may have
some common elements, viz., an internal judgment concerning the accuracy of an
interpretation of language.

Monitoring is implied more directly in Anderson's (1985) discussion of responses to ambiguity in comprehending natural language. Persons confronted with ambiguity tend to select an interpretation (a best guess) for a language pattern which will be carried through to the end of a sentence, or until it is found to be incorrect. The person must then repair the inaccurate interpretation by returning to the point of the original error and trying another interpretation. If the interpretation does not have to be changed it should have no further effect on processing. Monitoring should be evident because a representational process is required to contrast the initial interpretation with subsequent interpretations in which the word or concept is applied.

The second comprehension process that Anderson addresses incompletely is inferencing. This process involves predicting the meaning of an unknown word from context or other clues, or predicting information yet to be presented in a text. Anderson first discusses inferencing while describing the influence of schema on recall of new information in an extended written text. As discussed above, schema are complex networks of ideas surrounding a central concept. A person with imperfect recall of a text will infer the missing information consistent with their schema of key concepts that are related to the missing information (Anderson, 1985). The accuracy of recall in this instance depends on the verisimilitude of the schema to the information that was forgotten.

Anderson next discusses inferencing in the context of processes for handling ambiguous meaning. The context in which text occurs is important for supporting inferences about ambiguous meaning. The more elaborate the context, the more likely the person is to be able to identify the meaning of individual words and, by implication, to identify larger units of meaning such as phrases and propositions. What Anderson does not describe is the use of inferencing to determine the meaning of unfamiliar words and the specific cues that may be used for inferencing, as are treated in detail by Sternberg (1983). Nor does Anderson describe the use of inferencing to predict or anticipate future portions of extended text, as has been discussed by Palincsar and Brown (n.d.).

Applications to Second Language Acquisition. In the case of the L2 learner, imperfect knowledge of the rules of the new language can be expected to cause faulty parsing. Parsing by phrases and then combining the parsed phrases into an overall meaning representation assumes syntactical knowledge. The L2 learner who lacks complete syntactic control of the second language might encounter two types of difficulties in the process of concatenating constituents. One difficulty might involve failure to recognize a constituent. This may lead to inappropriate attempts to parse a string of words as if they were a constituent. An example of this type of difficulty with listening comprehension would be a sentence such as:

The train /blu/ its whistle as it rounded the bend.

The proficient English speaker would recognize that the complete subject of this sentence is the train. On the other hand, an ESL student whose native language places adjectives after the nouns they modify, might understand the complete subject as the train blue (or blue train) rather than recognizing blew as a verb. Thus, the expected word order of a constituent may influence the L2 learner's ability to parse successfully. A second difficulty which L2

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learners may encounter is in combining parsed constituents to render the meaning of the complete sentence. If even one of the constituents to be concatenated is imperfectly understood, this can have a negative effect on the accurate representation in memory of the entire sentence.

In addition to using syntactic patterns for parsing, semantic knowledge can be used to understand the meanings of individual words. World knowledge allows one to identify the probable relationship of one word to another in a sentence. Anderson (1980) indicates that semantic interpretation can override syntactic interpretation in some instances. This notion is of particular importance in studying how individuals approach the learning of a second language. L2 learners who view vocabulary development as the central task in learning the new language may be semantic rather than syntactic parsers. For such individuals, for example, passive sentences (considered more difficult to understand because of the reversal of the position of the agent and object), may not present any problem at all. A semantic parser may rely on logic and world knowledge to understand (without recourse to syntax) that The rat was eaten by the cat is identical in meaning to The cat ate the rat.

Semantic parsers may also have the ability to gain meaning by chunking, or accessing meaningful phrases as syntactically unanalyzed chunks of language. Wong-Fillmore (1976) and Ventriglia (1982), for example, have reported that children learning English as a second language demonstrate comprehension of unanalyzed formulas and phrases learned in a situational context by using them appropriately in speech. Wong-Fillmore (1976) found that it was through using such unanalyzed chunks and formulas in meaningful situations that children were able to analyze constituents of the chunks, look for recurring parts, and then make substitutions. This seems to indicate that semantic parsing preceded syntactic parsing.

Utilization. When a sentence has been parsed and mapped into a meaning, the listener will often try to relate the information to knowledge he or she has about the world. In memory, this amounts to juxtaposing the new information with respect to existing knowledge and establishing connections with existing ideas through a propositional network. The nodes (concepts) and relations (links) between nodes representing new knowledge are positioned into existing propositional networks thereby establishing connections between short-term and long-term memory.

Speakers tend to combine new ideas with the familiar as a means of building an understanding of their message in the listener. Anderson (1985) describes supposed information as ideas assumed by speakers to be already known by listeners, and asserted information as ideas assumed by speakers to be new or to require special emphasis. This distinction is also made by Clark (1976), who contrasts the part of a sentence that presents given information that the listener already knows, and the part that conveys the new information that speaker wishes to communicate. Clark indicates that the distinction between given and new information is important because it forms the basis for a tacit agreement between speaker and listener that allows the listener to assign the speaker's intended meaning to the sentence. Listeners may obtain cues for suppositions and assertions from various sources in communication, including the position of the item in the sentence (suppositions tend to be subjects of sentences, assertions are predicates), linguistic structures (e.g., the use of an adjective clause with a subject noun may signal stress on

the direct object), the intonational stress placed on the information (assertions are stressed), and the use of definite (supposed) or indefinite (asserted) articles. Thus, listeners may obtain cues to the meaning emphasized by speakers from a number of sources.

Probably one of the more important cues to meaning and the utilization of information is text structure. The meaning in written messages can be clarified through hierarchic organization and the use of superordinate and subordinate ideas. Superordinate ideas tend to be easier to remember. Anderson suggests the possibility of training students who are unsuccessful at detecting the organization of a text on procedures for identifying hierarchical structures (see Brooks & Dansereau, 1983; Taylor, 1982). Positive effects have been reported from training students to understand and use text structure as an aid to listening comprehension on academic tasks (O'Malley et al., 1985b).

Applications to Second Language Acquisition. The utilization stage of language comprehension can be a source of difficulty for the L2 learner. Speakers assume that listeners share some common information with them, and this is reflected by the supposition part of an oral message. When speakers err in their judgment of what information is shared, miscommunication occurs. With native speakers of a language, a repair strategy such as questioning for clarification quickly gets the conversation back on track. Non-native speakers may treat suppositions as new information, either because it __is__ new or because of difficulty in linking it to prior knowledge that was originally acquired through the L1. Because of limited proficiency in the L2, the non-native speaker may not know how to employ repair strategies, and so the miscommunication is not rectified. In addition to whatever linguistic difficulties L2 learners might encounter in interpreting the meaning of an assertion, they may be focusing so much attention on the supposition part of the message that little attention is available for comprehending the assertion.

Although Anderson (1980) states that the distinction between suppositions and assertions is part of language pragmatics, he does not address situations in which the supposition or assertion part of a message is implied but not actually stated. Clark (1979), however, has investigated this phenomenon of implied but not stated suppositions or assertions, which he terms __indirect speech acts__. An example of an indirect speech act would be a request such as, "Why don't you open the window a bit?" made in the context of an overheated room. The implied supposition is that both speaker and listener find the room too warm. In the same situation, the speaker might state the supposition only by saying, "It certainly is warm in here." This statement of the obvious is an indirect request for the listener to do something, such as open the window or turn on the air conditioner. Both utterances have the same language function, but differ not only in grammatical construction but also in the omission of either the supposition or assertion. Analysis and teaching of a second language by its functions rather than its grammatical forms has gained acceptance in recent years (Canales & Carter, 1985; Chamot, 1983; van Ek, 1977), and analysis of the supposition-assertion contrast in language functions could clarify areas of difficulty for L2 learners.

Another characteristic of a message is the structure of the oral or written text. A text is more readily comprehended when main ideas can be easily identified, and a text that is not organized in a "natural" structure

is difficult to understand (Anderson, 1980). Discourse structure can vary in different cultures, so that an organization that seems natural for an American English text may be unnatural in a Spanish or Vietnamese text. In an analysis of discourse structure used by students from different ethnolinguistic backgrounds, Kaplan (1966, 1976) found that text was organized in a variety of ways, all of them different from the linear organization characteristic of English text organization. On the other hand, Mohan and Lo (1985) found that Chinese texts had very similar discourse organization to English texts, and that difficulties encountered by Chinese students of English as a second language were largely developmental in nature. L2 learners may find it difficult to identify main ideas and important points when a text is structured in a different way, or their difficulties may be more at the sentence level. As discussed previously, story schemas are culturally determined, and it can be difficult to understand a story based on an unfamiliar schema or story grammar. Recent research tends to indicate that cultural differences in text organization in technical areas such as science are probably not as great as in narrative fiction. This could make such texts easier for L2 learners to understand because the text structure would be familiar.

Limitations of the Theory

Three qualifications to Anderson's theory of comprehension processes should be identified. First, the theory is based on research in first language comprehension. As Richards (1983) has noted, theoretical developments in second language comprehension processes have been drawn for the most part from studies of native language acquisition. The comprehension processes of proficient second language learners most probably resemble those of proficient native language speakers. Nevertheless, during initial stages of learning, there are likely to be systematic differences between second language and first language learners. At appropriate points in the discussion, we have highlighted differences between native and second language speakers that may occur during initial second language learning.

A second qualification regarding Anderson's views is that he equates listening comprehension to reading comprehension. The research and theoretical advantages to this approach are in identifying processes that are common to the two skills. However, paralinguistic elements of communication that are used to understand meaning in oral texts, such as pauses, intonation, and stress, are underrepresented in the theory. Where necessary to describe a comprehension activity, we have brought such paralinguistic elements into the discussion, sometimes drawing upon other aspects of Anderson's theory, and sometimes drawing upon other theorists.

The third qualification to Anderson's views of comprehension is that most of the work is based on isolated sentences rather than extended text. The task of L2 learners in classroom settings is to comprehend extended oral text in addition to isolated sentences. Only in the case of the influence of text structure on comprehension does Anderson address the use of extended text. However, even in this instance the theory is limited because the extended texts used in the studies referenced were written texts rather than oral texts. The fact that Anderson does not deal with comprehension in interactive conversations is not of concern to us at the present time because the focus of

the present research is on listening to extended oral text in instructional settings, where interaction is minimal.

Despite these limitations, our discussion of Anderson's theories of cognitive skill acquisition and comprehension processes has indicated that the application of a cognitive theory to second language acquisition can provide insights into the ways in which learners understand and remember the new language. The next section suggests how learning strategies can be accommodated in Anderson's model of cognitive skills acquisition, with particular reference to the use of learning strategies for comprehension processes in a second language. Finally, a model for research in second language comprehension is proposed and research questions arising from the model are identified.

LEARNING STRATEGIES

In this section of the paper we define and classify learning strategies and indicate how the strategies can be described within the framework of Anderson's cognitive theory (esp. Anderson, 1983). Anderson does not distinguish learning strategies from other cognitive processes perhaps because the theory focuses on describing how information is stored and retrieved, not on how learning can be enhanced. However, if one's purpose is to facilitate learning and teaching, there are advantages to isolating component strategies that can be imparted to learners as ways to make learning more effective. If learning strategies themselves are a learned skill, the processes by which strategies are stored and retrieved for future use must be identified. In Anderson's theory, strategies can be represented like any other complex skill, and described as a set of productions that are compiled and fine-tuned until they become procedural knowledge.

Definition and Classification

Learning strategies in the view expressed by Weinstein and Mayer (1986) have learning facilitation as a goal and are intentional on the part of the learner. The goal of strategy use is to "affect the learner's motivational or affective state, or the way in which the learner selects, acquires, organizes, or integrates new knowledge" (Weinstein & Mayer, 1986, p. 315). This broad description of learning strategies may include any of the following: focusing on selected aspects of new information, analyzing and monitoring information during acquisition, organizing or elaborating on new information during the encoding process, evaluating the learning when it is completed, or assuring one's self that the learning will be successful as a way to allay anxiety. Thus, strategies may have an affective or conceptual basis. Strategies may influence the learning of simple tasks, such as learning vocabulary or items in a list, or complex tasks, such as language comprehension or language production.

The subset of learning strategies that is concerned with conceptual processes that can be described in Anderson's cognitive theory is of principal interest in our analysis. Affective strategies are of less interest in an analysis which attempts to portray strategies in a cognitive theory. For purposes of discussion here, however, we present a classification scheme that

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includes the full range of strategies identified in the literature. The examples we select concentrate on strategies that are applicable in listening comprehension. After presenting the classification scheme and examples, we then illustrate how selected strategies with a conceptual basis can be defined in the context of Anderson's theory.

Learning strategies have been differentiated into three categories depending on the level or type of processing involved (O'Malley et al., 1985). Metacognitive strategies are higher order executive skills that may entail planning for, monitoring, or evaluating the success of a learning activity. Metacognitive strategies are applicable to a variety of learning tasks (Nisbet & Shucksmith, 1986). Among the processes that would be included as metacognitive strategies for listening comprehension are the following:

- selective attention for special aspects of a learning task, as in listening for key words or phrases;

- monitoring or reviewing comprehension for information that should be remembered while listening; and

- evaluating or checking comprehension after completion of the listening activity.

Cognitive strategies operate directly on incoming information and manipulate the information in ways that enhance learning. Weinstein and Mayer (1986) suggest that these types of strategies can be subsumed under three broad groupings that include rehearsal, organization, and elaboration processes. Cognitive strategies may be limited in application to the specific type of task in the learning activity. Typical strategies included in the cognitive category for listening comprehension are the following:

- rehearsal, or repeating the names of items or objects that have been heard;

- organization, or grouping and classifying words, terminology, or concepts according to their semantic or syntactic attributes;

- inferencing, or using information in oral text to guess meanings of new linguistic items, predict outcomes, or complete missing parts;

- summarizing, or intermittently paraphrasing what one has heard to ensure the information has been retained;

- deduction, or applying rules to understand language;

- imagery, or using visual images (either generated or actual) to understand and remember new verbal information;

- transfer, or using what is already known to facilitate a new learning task; and

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- elaboration, i.e., linking ideas contained in new infor-
  mation, or integrating new ideas with known information
  (elaboration may be a general category for other strate-
  gies such as imagery, summarization, transfer, and
  deduction).

Social/affective strategies represent a broad grouping that involves
either interaction with another person or ideational control over affect.
Social/affective strategies are generally considered to be applicable to a
wide variety of tasks. The strategies that would be useful in listening
comprehension are as follows:

- cooperation, or working with peers to solve a problem,
  pool information, check a learning task, or get feedback
  on a learning activity;

- questioning for clarification, or eliciting from a teacher
  or peer additional explanation, rephrasing, or examples;
  and

- self-talk, or using mental control to assure one's self
  that a learning activity will be successful or to reduce
  anxiety about a task

Strategies as Cognitive Processes

At least two sets of questions about learning strategies are raised by
Anderson's cognitive theory. The first concerns the way in which strategies
can be described within the context of the theory. That is, where do the
strategies appear in the theory, what terms are used to refer to them, how do
they function, and what role do they serve? The second set of questions con-
cerns how the strategies may be learned by a person who does not presently use
them on a task where they might facilitate learning. Are strategies like
other learned information, what type of information do they most resemble, how
are they stored, and how can they be learned and retained for use with a
variety of tasks?

Metacognitive Strategies. Procedural knowledge is the basic mechanism
through which control over cognition is exercised in Anderson's theory.
Lachman et al. (1979) used the analogy of declarative knowledge resembling
data in a computer while procedural knowledge represents the software program.
Procedural knowledge as represented in production systems is used to examine,
test, and modify the procedural system as well as to extend the system's range
of control. Production systems by definition have a goal statement as the
condition (IF) preceding an action (THEN), and therefore provide direction in
planning future thoughts or behavior.

Planning is a procedure for conflict resolution among competing action
statements which might apply to the conditional clause in the production.
Planning may be influenced by goals or by input features that seem most useful
for performing a task. The significance of goals is suggested in the distinc-
tion between top-down processing, which capitalizes on known information, and
bottom-up processing, which starts with features of the input. Learners are

often viewed as top-down processors who successively refine higher level goals into achievable actions. Anderson suggests that individuals may also plan opportunistically and alternate between top-down and bottom-up processing depending on the task demands. This view is consistent with our characterization of listening comprehension, where an individual may alternate processes depending on the difficulty of the specific language items contained in the text, or at which stage of learning the individual happens to be functioning with any item of input. We also indicated that top-down processing can involve attending to the overall meaning of phrases and sentences rather than their linguistic features, as would be involved in bottom-up processing.

Two other metacognitive processes that are described in Anderson's (1983) theory are selective attention and monitoring. Attentional processes are an important part of the perceptual processing that occurs during listening comprehension in Anderson's theory. Attentional processes are limited in both scope and capacity as evidenced in the difficulty individuals have in processing more than one complex task at a time and in holding in short-term memory more than a modest amount of information. However, highly practiced skills may require little attention and involve **automatic** processing, while skills that are less practiced require the full attention of the listener and involve **controlled** processing. Listeners to a second language may be unable to distinguish between word and phrase boundaries in the early stages of L2 acquisition. The listener seeks but is unable to locate identifiable segments of the oral text on which to focus attention. The inevitable result of this difficulty in attention is poor comprehension. Given that attentional processes are limited, training on learning strategies that includes selective attention for key words, phrases, or word/phrase boundaries could be an important facilitator of the learner's efforts.

Monitoring in Anderson's view is a response to ambiguity in comprehending language where an individual selects a best guess of the message's meaning based on available information. This was reviewed under our section on **parsing**, where we indicated that a listener may have to monitor subsequent input relative to the initial guess and perhaps retrieve and modify earlier comprehension errors. Monitoring is also involved in control processes and in opportunistic planning because a learner will analyze task demands to determine the task difficulty and the appropriateness of top-down or bottom-up processing.

We made the point earlier that monitoring was described incompletely by Anderson and suggested that this construct has considerable potential for adding to the description of learning processes. The issue that needs to be addressed more explicitly in a theory concerned with listening comprehension is the cues to which individuals attend that assist learning. For example, Markham (1981) has identified internal monitoring signals that learners can use in detecting failure to comprehend verbal materials, such as perceived absence of structure and perception of inconsistencies. Nisbet and Shucksmith (1986) suggest that monitoring is the key process that distinguishes good learners from poor learners. In their view, monitoring is the ability to analyze the demands of the task and to respond appropriately, i.e., to recognize and manage the learning situation. Monitoring can be described as being aware of what one is doing or bringing one's "mental processes under conscious scrutiny and thus more effectively under control" (Nisbet & Shucksmith, 1986, p. 7). Weinstein and Mayer (1986) add that monitoring involves setting goals

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for learning and deploying alternative procedures when the goal is not met. They also present evidence emphasizing the central role monitoring plays in effective learning and supporting the responsiveness of monitoring to strategy training.

Cognitive Strategies. Anderson's (1983) theoretical analysis of cognition includes descriptions of a number of strategy-like cognitive processes including imagery, organization, inferencing, elaboration, deduction, and transfer. Elaboration will be seen to play a key role in describing both deduction and transfer.

To Anderson, images are one of three ways in which information is stored in memory; the others consist of temporal strings and propositions. Spatial images are subject to the same short-term memory limitations as propositions, and consequently are retained ins terms of an abstraction of the original object or scene. Anderson's theoretical description of images is concerned primarily with topics such as the ability of individuals to match patterns similar to an original figure, perhaps rotated or segmented, and to identify patterns with and without supporting organization or context. However, the importance of images in listening comprehension is that they may assist in recalling verbal material.

Anderson (1980) suggests that verbal-imagery linkages may be useful in learning vocabulary, as in the keyword method, but dismisses the usefulness of connections between visual images and meaningful verbal information. Weinstein and Mayer (1986) implicitly support this distinction by classifying imagery as a strategy that is useful for "basic learning tasks" such as vocabulary or word lists. The keyword method has been found to be successful for these kinds of materials in foreign language learning (Atkinson & Raugh, 1975; Pressley, Samuel, Hershey, Bishop, & Dickinson, 1981). Anderson (1985) also reports evidence indicating that the method of loci, another visual mnemonic device, is effective in assisting recall of unconnected verbal materials, but concludes that strategies that capitalize on the inherent meaningfulness of information should be more useful than attempting to represent the information visually given the capacity limitations of short-term memory.

Anderson's (1985) discussion of organization or grouping as a strategy for listening comprehension is embedded in his description of parsing productions. Individuals listening to extended oral texts segment or chunk information into words or phrases depending on the level at which the information is most meaningful. As we noted above in our discussion of selective attention, listeners may focus on either meaning-related aspects of words or linguistic characteristics. Organizational strategies are also useful for building connections between related ideas, as is discussed below under elaboration.

Strategic uses of inferencing are only addressed in part by Anderson's theory. While he indicates the role inferencing plays in recall, the focus is either on the contributions to comprehension made by prior knowledge (schema) or on the characteristics of text which make it ambiguous, rather than on inferencing strategies learners can use to deal with ambiguity. Inferencing has rich possibilities in comprehension tasks as suggested by Sternberg's work on training the cues individuals can use to assist comprehension (Sternberg,

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1983; Sternberg & Powell, 1983; Sternberg, Powell, & Kaye, 1982). Sternberg notes that the high correlation found between tests of vocabulary and intelligence may result from the fact that vocabulary tests are indirect measures of the ability to acquire new knowledge or the ability to infer meanings of unfamiliar words from context. Sternberg suggests that, in addition to the usual linguistic cues, there are a variety of cues in a text that individuals can use to infer meaning of a word in context, such as classifications, attributes, causal relations, or temporal or spatial relations. The learner should weigh the importance of the word for overall text comprehension before applying the cues, selectively combine information from the cues to derive the definition, and compare the definition in its context with existing knowledge for related words or concepts. Sternberg has developed a training program in which these strategies are embedded (Sternberg et al., 1982).

Probably Anderson's strongest contribution to cognitive strategy applications is his discussion of elaboration with meaningful texts. Elaborated memory structures are powerful aides to recall that exert their influence through spreading activation. The influence may occur by (a) redirecting activation away from interfering paths and toward paths which lead to the target concept; (b) spreading activation toward concepts that were part of the study context; and (c) enabling a reconstruction of the original text through inferences based on information available at the time of recall. That is, individuals can enhance memory for concepts if they increase the number of related ideas that are present at the time of study, or increase the number of related ideas that are present at time of recall. Either approach will work and will contribute even further to recall if the related ideas are part of a schema constructed out of prior knowledge through which a broader range of elaborations is available. Anderson indicates clearly in his discussion of elaboration that individuals can be encouraged successfully to elaborate on meanings to enhance memory with meaningful information.

Elaborated structures are the foundation for describing deductive strategies and transfer. Schema that are based on rules (linguistic or paralinguistic) for language use enable deductions to be made about meanings of words or phrases. The learner may apply grammatical rules, discourse rules, sociolinguistic rules, or rules developed idiosyncratically to gain an understanding of extended oral text. These schema-based rules are part of declarative knowledge but may become procedural knowledge with increased language proficiency. A second type of schema is based on world knowledge and enables the person to transfer information to the present learning environment that will assist in comprehension, efficient storage into an existing schema, or retrieval at the time of recall. As we discussed earlier, world knowledge can originate in either L1 or L2.

Strategy Representation and Acquisition. Learning strategies are complex procedures that individuals apply to tasks; consequently, they are a form of procedural knowledge and may be acquired through cognitive, associative, and autonomous stages of learning. As with other procedural skills at the different stages of learning, the strategies may be conscious in early stages of learning and later be performed without the person's awareness. Because strategies are complex skills, a person attempting to apply an unfamiliar strategy to a demanding task will have difficulties in controlled processing that can be anticipated from performing two complex tasks simultaneously.

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Strategy applications resemble production systems with a condition (IF) and one or more action (THEN) clauses, as in

> IF the goal is to comprehend an oral text,
> and I am unable to identify a word meaning,
> THEN I will try to infer the meaning from context.

Because controlled processing places an extra burden on attentional processes, the learner might easily be inclined to reduce the cognitive load by not performing the strategy or by using a less efficient strategy. In the example above, the person might guess at the meaning without using contextual clues, which more often would lead to an incorrect inference. The learner who sees the task as too familiar may not be inclined to use a new strategy but may rely upon automatic problem solution strategies (productions) that have already been learned. Guessing without using contextual clues is a good example in this instance. Thus, the dilemma of strategy training is that learners will avoid strategies with tasks that are too difficult or too easy. Transfer of the strategies to similar tasks--or generalization of the production system, in Anderson's terms--is based on a pattern matching condition in which the learner recognizes similarities between new tasks and tasks involved in former strategy applications. If the learner recognizes these similarities, the conflict over which alternative productions (i.e., other strategies) to select is resolved and the learner is more likely to apply the production representing the strategy intended.

One of the principles in Anderson's theory that helps resolve the conflict between competing productions is goal-dominance or the salience of a goal for one production over another. Productions that refer to a current goal take precedence over productions that might apply because of strength of association. Thus, a learner with an explicit goal to use a strategy included in training will be able to apply it to the task even though other productions (strategies) may be competing. What is required, however, is intentional control over the learning situation.

A number of writers have commented on the difficulty of strategy training and the problem of furthering strategy transfer (Derry & Murphy, 1986; Nisbet & Shucksmisth, 1986). Derry and Murphy distinguish between detached training, which trains students to use strategies independent of the context provided by any specific curriculum, and embedded training, which trains students to use strategies with specific subject matter courses. Whereas detached training may be generalizable across a variety of subject areas, it may fail in promoting strategy use beyond the immediate training environment. Conversely, whereas embedded training may encourage strategy use in specific subject areas, it may fail in promoting strategy use in other subject areas. Nisbet and Shucksmith refer to this as the "skills dilemma," and suggest that it can be overcome by making the transferable elements in different subject areas explicit for the learner. Derry and Murphy (1986) suggest the use of an "incidental learning model" that consists of "well-planned, short programs of detached strategies training, including tactics and tactics-utilization training, followed by unobtrusive prompting in the actual instructional environment" (p. 32).

A MODEL FOR RESEARCH

In previous sections we have described applications of Anderson's (1980, 1983, 1985) general cognitive theory to second language acquisition. The theory identified representational processes with two languages and suggested that language acquisition follows the pattern of acquiring procedural knowledge as represented in production systems. The theory provided extensive information on how learners build an understanding of a second language through successive stages of skill acquisition and how they process information while listening. The theory was also used to gain insights about the factors that support second language acquisition and that should be considered during second language instruction. Finally, we illustrated how the theory can describe learning strategies as procedural knowledge and identified problems that need to be overcome in strategy training.

In this section, we describe a model for research to guide future studies of listening comprehension in second language acquisition. The model is quite modest in simply identifying, first, the major research questions that emerge from our presentation of the cognitive theory and, second, research approaches that will be useful in pursuing these questions. Although the research model is not complex, the range and depth of questions it addresses correspond to the issues raised in the cognitive theory. Thus, the model has the virtues of comprehensiveness and sensitivity to significant issues in cognitive processing and second language acquisition.

Research Issues

The research questions we identify are divided into four major sections: (a) representation of knowledge in memory for speakers of a second language; (b) conceptual processes underlying second language acquisition; (c) the process of listening comprehension in a second language; and (d) the utility of learning strategies in second language acquisition. At appropriate points in the discussion, we comment on the relevance to the research questions of issues concerning the characteristics of learners (L2 proficiency, skill as a learner, prior knowledge) and the nature of the materials (difficulty, structure). The task of interest in each of the research questions is second language listening comprehension.

Knowledge Representation. The theory of conceptual processes in second language acquisition suggests that information is stored as either declarative knowledge or procedural knowledge. With regard to declarative knowledge, questions that emerged from our discussion were as follows:

● Is declarative knowledge stored separately in two
languages or as a single system? At what stage of L2
proficiency or experience do second language learners
begin to build propositional networks or schema that can
be used in L2?

● What processes are involved in transfer of information for
use in L2? Is transfer dependent upon the materials or
characteristics of the learner? How is information in L1
linked to information in L2?

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- How does metalinguistic information influence memory or performance? Are there differences in metalinguistic information depending on characteristics of the learner?

Other questions pertained directly to procedural knowledge, and particularly to product systems. As we have noted, language is acquired like a complex skill and can be described as procedural knowledge. Production systems are of particular interest in the questions we present, since the storage and use of language is dependent upon the ways in which productions operate. Thus, an understanding of production systems is essential to identifying how information about language functions in listening. The research questions are as follows:

- Are there language-specific production systems in L2? Are the productions based on familiar linguistic rules, paralinguistic rules, or idiosyncratic rules? Can they be described and do they differ depending on whether the learner is an effective or ineffective learner of L2?

- Do production systems in L1 have common features with those in L2? That is, if there are separate systems for each language, do the productions in L1 have common features with those in L2?

Second Language Acquisition. The next set of research questions focuses on specific mental processes underlying second language acquisition. The theory indicated that complex cognitive skills such as language are acquired in a three-stage process represented by a cognitive stage, an associative stage, and an autonomous stage. The questions concern differences in conceptual processing at each of these stages during L2 acquisition and are as follows:

- How do the three stages of skill acquisition relate to the mental processes used by learners at different levels of L2 proficiency? Do learners begin at the cognitive stage by using rules, proceed to an associative stage where they increase processing speed and reduce errors, and then progress to an autonomous stage where they have achieved a higher level of proficiency and may no longer remember some of the initial rules?

- Do all rules for language use follow the stage-wise pattern from cognitive to associative to autonomous learning? Are there differences in this regard among linguistic, sociolinguistic, discourse, and strategic rules?

- Do second language learners process difficult information at earlier acquisition stages, while other input in the same phrase or sentence may be processed at the more automatic stage? Do they switch back and forth from one stage to another depending on the difficulty of the input?

- What is the relationship between stages of skill acquisition in a second language and later attrition? Is the information retained procedural rather than declarative knowledge, and is the information retained at the autonomous rather than the cognitive stage of skill acquisition?

Listening Comprehension. Anderson's theory indicates that language comprehension occurs in a three-step process involving: (a) perceptual processes (attention and speech recognition); (b) parsing, or segmenting speech into identifiable components and concatenating the components to achieve larger units of meaning; and (c) utilization, or bringing existing knowledge forward from long-term memory to apply in understanding or in retaining new information. The research questions related to language comprehension are as follows:

Perceptual Processes

- When and why do listeners reach a point of saturation where they are unable to attend further and shift their attention away from the task? Are there differences in attention depending on characteristics of the learner or the materials?

- Do some listeners process extended text based on meanings while others process individual words or phrases syntactically? Does the size of the unit processed vary among listeners? Do these processing features differ depending on characteristics of the learner or the materials?

- Do beginning listeners in the L2 focus on the same or different aspects of the language, such as individual words, phonological patterns, or unanalyzed syntactical units? Is there a sequence in which listeners attend to these language aspects at different stages of learning?

- With what kinds of input are listeners capable of parallel processing? Is this related to the listener's proficiency or other characteristics?

- How do affective factors contribute to or detract from attention in L2 listening comprehension?

Parsing

- Are difficulties in sustained attention with listening comprehension related to the individual's procedures used in parsing? Do individuals translate meaning from L2 into L1, thereby creating additional cognitive demands?

- What is the basis for parsing in L2 listening comprehension? What is the unit of meaning and how large is a chunk of information? What operating rules do listeners look for as a basis for parsing? Are the rules concerned

with syntactic or semantic features of language? Does
this differ depending on the type of learner?

- How do individuals concatenate parsed productions into
larger units? What does the larger unit consist of?

Utilization

- How do individuals use prior knowledge in assisting their
comprehension of information in L2? Does this depend on
the characteristics of the learner, such as degree of
knowledge in the Ll, particularly among students with
interrupted prior education? Does it depend on the pro-
ficiency of the study or the learner's effectiveness?

- How do students use Ll knowledge for tasks in L2 and what
types of knowledge do they use?

Learning Strategies. An initial distinction was drawn between meta-
cognitive, cognitive, and social/affective strategies. The theory of cog-
nitive processing was then used to describe selected metacognitive and
cognitive learning strategies, to indicate the role of learning strategies in
second language comprehension, and particularly to portray the importance of
control processes for guiding the learner's activities. The way in which
strategies may become part of a learner's repertoire of skills was also
described within the theory. Learning strategies are best described as
declarative knowledge when they are initially being learned but may become
proceduralized as use of the strategy becomes more practiced. The research
questions concerning learning strategies are as follows:

General

- How are strategies acquired? Are strategies acquired like
other complex skills through cognitive, associative, and
autonomous stages? That is, how does the change from de-
clarative to procedural knowledge occur with strategies?

- What factors contribute to strategy transfer? Is pattern
matching a key element? What is the role of metacognition
in strategy transfer or of planning and monitoring?

- Which strategies (particularly metacognitive and cognitive
strategies) are used by different learners for different
types of materials? That is, do strategy applications
differ depending on the learner's level of proficiency or
learning effectiveness? Does strategy use differ for
difficult vs. easier materials? Do students continue to
use some strategies over time with similar tasks?

Metacognitive Strategies

- What role do control processes lay in listening compre-
hension? More specifically, is there evidence of top-down

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or bottom-up processing in listening? Do listeners use opportunistic planning in shifting from top-down to bottom-up processing depending on the materials? Does this vary with characteristics of the learner?

- Does monitoring play the important role in listening comprehension that it appears to in other learning tasks? Do listeners set goals for learning, analyze the nature of the task, and adjust strategies depending on their progress?

Cognitive Strategies

- Are there individual differences in what strategies work for effective learners? Is it more important to teach specific strategies for specific tasks or to teach a varied repertoire of analysis and application strategies?

- What cues do learners depend on for inferencing in listening comprehension? Do listeners use contextual cues, linguistic cues, or both, and do they decide upon the importance of a word for overall comprehension of a passage before using inferencing?

- Is there evidence of elaboration at the time of initially hearing a passage as well as at the time when an effort is made to recall it? What types of linkages formed among related concepts appear to aid retrieval? Are the linkages propositions, networks, or schemas?

- Does the prior L2 experience of students appear to influence the strategies they use, whether from prior experience with other second languages, or direct training on strategies in L2 classes? Do the materials that students are accustomed to using in class influence the strategies they use?

- Are some strategies maladaptive? That is, do students sometimes select an approach for listening that does not assist comprehension but persist in the strategy use nevertheless?

Approaches for Research

Learning processes and strategy uses are elusive topics of research in that the procedures used in data collection can influence the nature of the information obtained and the conclusions which are drawn. Investigators who ask for retrospective information about strategy use can expect to obtain different types of information than those who ask students to think aloud while they are performing a listening comprehension task. Similarly, while interview procedures may be useful in obtaining general information about strategy use, they may not be productive in delineating specific information about the networks linking concepts in memory. This elusiveness leads us to

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recommend varied research approaches that should converge in drawing conclusions about conceptual processes involved in second language listening comprehension. At least four approaches seem most useful to us in addressing the research questions described above: interview techniques, lexical decision research, computer simulation of listening comprehension, and training research.

Interview Techniques. In our own studies over the past four years we have relied heavily upon retrospective interviews to gain an initial understanding of the definition and classification of strategies used in second language acquisition for both receptive and productive skills (O'Malley et al., 1985a; 1985b). We were interested in the frequency of strategy use among learners at different stages of language acquisition with different types of language tasks. With the addition of the perspective gained from cognitive theory, we are now able to refine the types of questions we ask and to direct both basic and applied components of the research toward issues that will build knowledge systematically about second language acquisition.

In the present study, we are using "think aloud" procedures to gain an in-depth view of the processes used in second language listening comprehension. The focus is on students learning English as a second language, as it has been in our previous work. The contribution made by the think aloud technique will be to inspect some of the earlier conclusions in greater detail with concurrent rather than retrospective memory and to gain additional knowledge about how learners process second language input. We are also now varying the materials in difficulty and varying the characteristics of the learners. Whereas in our previous work we concentrated on describing the strategies used by effective learners, we now are able to contrast those strategies with the strategies used by learners who have been designated as ineffective. Because we are now conducting repeated think aloud interviews with students, we are able to track the continuity of strategy use over time. Perhaps most importantly, the strategies students use can now be described within the context of an articulated theoretical position.

As a complement to the present study, we are conducting a three-year investigation of the influence of learning strategies on foreign language acquisition in Spanish and Russian that is being supported by the U.S. Department of Education. The purposes of the foreign language study are: (a) to identify the type of strategies used by students studying foreign languages; (b) to determine continuity of strategy use by students over time; and (c) to examine the effects of strategy training in natural classroom settings by the students' instructor. We are using think aloud procedures to look at characteristics of students (effective vs. ineffective learners) at three different levels of L2 proficiency (beginning, intermediate, advanced), and are analyzing strategies used in all four language skills (listening, speaking, reading, and writing) rather than in listening comprehension alone, as in the English as a second language study. We expect that the theoretical developments made in the present work will add significantly to the design and analysis of the foreign language study.

Lexical Decision Tasks. One of the research questions that interview techniques can address only partially concerns the storage of information in separate memory locations specific to each language or in a common language-free area. This is a crucial question for theory in second language

acquisition. Another way to phrase the question is in terms of the strength of association of concepts along connecting pathways in memory. Learners with strong connecting networks or schema specific to a language would be expected to have difficulty or to be slower in responding to an L2 word or concept than if the same word were presented in L1. One way to test this prediction is to present L1 context cues for an L2 word and measure the listener's reaction time compared to that obtained when cues are presented in L2. The methodology used in conducting this type of investigation is referred to as lexical decision research (Swinney, 1979).

Computer Simulation. In addition to interviews and studies of memory processes performed through reaction time studies, an additional source of evidence can be supplied from computer simulations of second language comprehension. The theoretical model of second language comprehension processes we have presented permits the components of comprehension and second language acquisition to be specified in sufficient detail so that the important elements and their relationships could be simulated on a computer. The theory has described conceptual processes involved in information storage, retrieval, and acquisition, and it has suggested learning strategies that have facilitated acquisition of second language skills. However, the data identifying specific elements involved in second language comprehension processes may be incomplete. The advantage of a computer simulation is in being able to observe the results of varying the parameters of the model, in specifying which parameters are of interest at any moment, and in identifying elements of the model that have not been specified at all or that have been specified incompletely (Thibadeau, Just, & Carpenter, 1982). Furthermore, in a computer simulation, complex states can be specified completely that would be difficult to control in studies involving human subjects. Computer simulation can also be used in examining the influence of learning strategies on second language comprehension outcomes. One of the areas that may be of most interest in computer simulation is the degree and mix of pattern matching and control processes that will result in effective transfer of learning strategies with second language comprehension.

Training Research. The final area of research that follows from our earlier discussion is training in the use of learning strategies. Our earlier work in this area successfully demonstrated that learning strategy training was effective for certain listening comprehension and speaking tasks in an academic setting (O'Malley et al., 1985b). This continues to be the only experimental training study of learning strategies in second language acquisition. However, extensive contributions have been made to strategy training research in recent work with other cognitive tasks (e.g., Derry & Murphy, 1986; Gagne, 1986; Weinstein & Mayer, 1986), and particularly to the awareness of conditions for training that should be met if strategies are to transfer. A reasonable complement to this work and to the computer simulation of second language comprehension would be to examine the effects of computer training in learning strategies for listening comprehension among second language learners. The use of intelligent computer-assisted instruction (ICAI) in training can be used to build on the computer simulation research, emulate a personal tutor with a basis in cognitive theory (Anderson, Boyle, Farrell, & Reiser, n.d.), represent expert production systems, and incorporate a learning strategies approach in instruction.

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In second language acquisition, existing exploratory work with interactive videodisc (Raschio & Lange, 1984) can be combined with ICAI where learners examine the consequences of production system rules for language use in authentic interactive language settings and thereby gain in functional proficiency. Learners may, for example, test out and refine their understanding of sociolinguistic or discourse rules by observing the responses of individuals on the video enacting specific decision alternatives they have designated. The learner therefore has an opportunity to use a rule as the basis for language production, use the language in an authentic context, and listen to and emulate the phrasing used by live models so that production rules (based on grammatic, sociolinguistic, or discourse principles) become proceduralized knowledge over the course of training.

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